

---

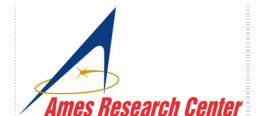
# Development of Modeling & Simulation Capability Driven by Concepts

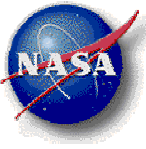
Len Tobias

NASA Ames Research Center

VAMS TIM #2

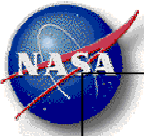
August 27, 2002





## What will be discussed

- Not: What will be needed to completely evaluate all the proposed concepts?
- Rather: What is the most effective means of letting the concepts drive the modeling and simulation development?



## Concept Developers

Description

Analytic basis

Simulation validation

## VAST

General performance assessment

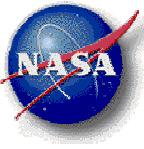
Verify developer's claims

Supports comparison with other  
candidate concepts

Integrate concept with others

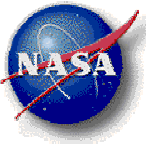
Concept  
Software

Simulation  
Framework



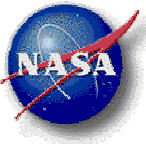
# Outline

- Review of selected concept proposals
- Modeling and simulation requirements based on the concepts
- Issues: given finite time, staff and \$, how should we proceed?
- Guidelines for selecting what to address



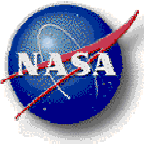
## Summary of System Level Concepts

- All Weather Maximum Capacity Concept (Metron):
  - Weather reduces capacity. Prediction of weather (e.g., winds aloft, gusts, icing, turbulence, fog) will improve. This in itself can improve the ATM planning process. But we can also develop dynamic optimized routing procedures to handle weather-related problems more effectively.



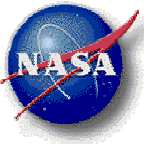
## Summary of System Level Concepts (2)

- Massive Point-to-Point (PTP) & On-Demand Air Transportation System Investigation (Seagull):
  - The hub and spoke system is congested. Use the over 5000 under-utilized public airports to provide PTP operations, which will avoid hubs whenever possible. Some key characteristics of this will be: on-demand operations, greater ATM automation and flexible routing.



## Summary of System Level Concepts (3)

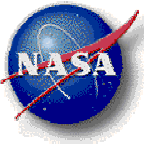
- Air Transportation System Capacity-Increasing Concepts Research Proposal (Boeing):
  - The existing constraint set limits capacity. However, by 2010, three key elements (National Flow Management, Common Information Network and Common Information Base) will have been implemented. Use these elements to eliminate existing constraints.



## Summary of System Level Concepts (4)

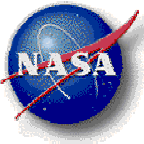
- Concepts for System-wide Optimization (NASA):
  - For the present system, use existing rerouting schemes (e.g., Playbook) and optimize flow rate to meet demand. For future systems, develop fully optimal routing.





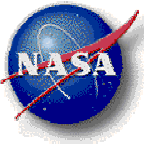
## Summary of Domain-Specific Concepts

- Capacity Improvements Through Automated Surface Traffic Control (Surface; Metron):
  - Use automation to generate clearances based upon complete, conflict-free airport surface paths. Communicate clearances to pilots via control of runway lighting. The assumption is that there will be multiple data sources (ARTS, ASDE-X, ADS-B) available and multiple advisory concepts (AMASS, SMS) operational.



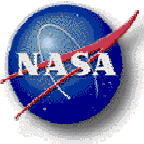
## Summary of Domain-Specific Concepts (2)

- Surface Operation Automated Research (SOAR) (Surface; Optimal Synthesis):
  - Start with a ground-control automation system (GO-SAFE) and an FMS-based aircraft clearance system for precision taxi (FARGO). Use these to build a tightly integrated automation system for surface operations.



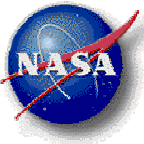
## Summary of Domain-Specific Concepts (3)

- Centralized Terminal Operation Control (CTOC)  
(Terminal; Northrop Grumman):
  - Analogous to the Maritime Industry's Harbor Pilot, the concept proposes remote control of aircraft in the terminal domain as a means of addressing current spacing inefficiencies of today's terminal operations. Pilots and controllers can assume control for safety/security reasons.



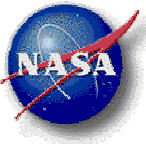
## Summary of Domain-Specific Concepts (4)

- Terminal Area Capacity Enhancement Concept (TACEC) (Terminal; Raytheon):
  - Blend the following capabilities to increase the capacity of terminal area operations: airborne self-separation, 4D, complex final approaches and others. The assumption is there will be improved surveillance, reliable/secure data link, enhanced weather prediction capability.



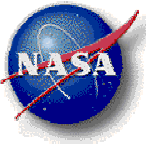
## Summary of Domain-Specific Concepts (5)

- Advanced Airspace Concept (Enroute; NASA):
  - An automation system to generate efficient, conflict-free clearances and send them to aircraft via data link. The system is backed by a safety net (TSAFE) which monitors clearances and conformance.



# What Modeling & Simulation Needs to Address

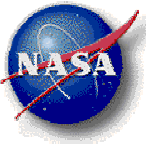
- Existing ATM Framework
  - Aircraft
  - ATC
  - System Command Center
  - Airline Operations Center
  - System operations
    - Capacity, delays
    - Sector & route structures
    - Planning
    - Equipage
    - Constraints



---

# What Modeling & Simulation Needs to Address (cont.)

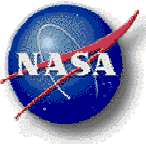
- Innovations
  - CNS Technology
  - Broader access to information
  - Distributed management
  - Flexibility
  - Automation
- Impacts
  - Safety
  - Security
  - Environment



# Issues for Simulating Capacity Concepts

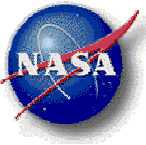
- General
  - What is a concept?
    - What isn't a concept
    - Level of specificity
    - How “imperfections” are addressed
  - What is capacity?
    - 3X: is it worth simulating?
    - Capacity vs. cost





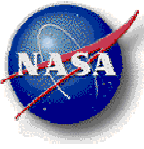
## Issues for Simulating Capacity Concepts (2)

- Evaluation
  - What is the desired approach in evaluating system-wide concepts vs. domain specific concepts?
  - How do we select what to simulate?
    - Number of concepts
    - Commonality of features
    - Concepts which require facilities we need to develop
    - Concepts for which specific impact is critical



## Issues for Simulating Capacity Concepts (3)

- Evaluation (continued)
  - How do we design the simulation environment?
    - Selection of sites
    - Assumptions about future systems
    - Consistency of fast and real time simulation
  - How do concepts need to interact with each other and with the simulation environment?
    - Concepts additive or in competition?
    - Integration of concepts into the real time system
  - Specific evaluation issues



---

## Suggested Guidelines on How to Use Concepts to Drive the Modeling & Simulation Development

- Build capability which incorporates features common to many concepts (improved weather prediction, flexible routes and sectors, common information network), but focus should be errors, deviations, abnormalities
- Limit details of models for system-wide concepts to address broad questions)
- Evaluate & compare two domain-specific concepts
- Integrate two concepts
- Evaluate one concept's impact on security, safety or environment
- Develop issue-driven AOC & SCC models